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Students
First !

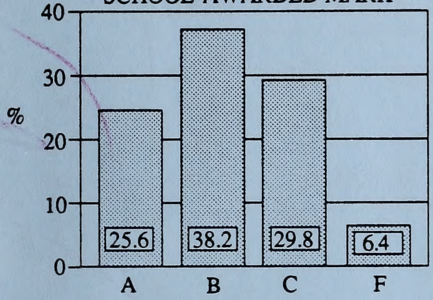
**EXAMINER'S REPORT**
**JANUARY**
**1990**

CANADIANA
APR 25 1990

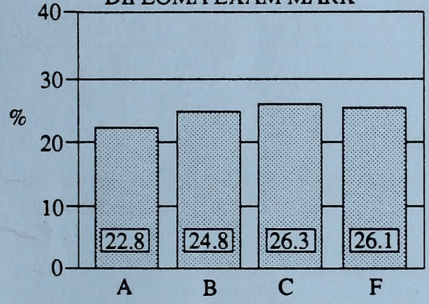
**Student Evaluation and Records**

# Physics 30 Diploma Examination Results

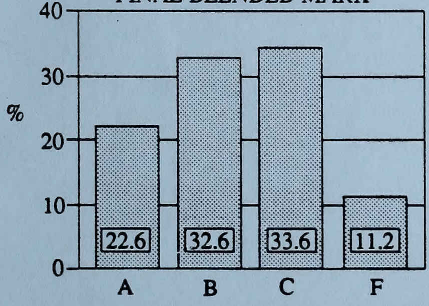
SCHOOL-AWARDED MARK



DIPLOMA EXAM MARK



FINAL BLENDED MARK



The summary information in this report is intended to provide teachers, school administrators, students, and interested others with an overview of results from the January 1990 administration of the Physics 30 Diploma Examination. The information will be most useful when teachers and administrators use it in conjunction with the detailed school and jurisdiction reports that have been mailed to school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January and June results will be distributed in the fall of 1990.

## DESCRIPTION OF THE EXAM

The Physics 30 Diploma Examination consists of two parts: a multiple-choice section of 49 questions worth 70% of the total, and a written-response section of four questions worth 30% of the total.

## ACHIEVEMENT OF STANDARDS

The information reported is based on the final blended marks achieved by 3 121 students who wrote the January 1990 Physics 30 Diploma Examination.

- 88.8% of these students achieved the acceptable standard (a final blended mark of 50% or higher).
- 22.6% of these students achieved the standard of excellence (a final blended mark of 80% or higher).

## PROVINCIAL AVERAGES

- The average school-awarded mark was 69.3%.
- The average diploma exam mark was 63.1%.
- The average final blended mark, representing an equal weighting of the diploma and school marks, was 66.6%.

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EDUCATION

## SUBTEST RESULTS

When analysing any detailed examination results, please bear in mind that subtest averages **cannot** be directly compared.

Machine scored: 69.0%

Written response: 48.9%

- Course Content
  - Light: 56.6%
  - Electric and Magnetic Fields: 69.6%
  - Electromagnetic Radiation: 54.3%
  - Structure of Matter: 68.4%
  - Modern Physical Theories: 62.2%
- Process Skills: 53.9%
  - Multiple-choice questions 2, 4, 5, 7, 17, 20, 21, 23, 26, 28, 35, 36, 41, 43, 47, and 48, and written-response questions 1, 2, 3, and 4.
- Cognitive Levels
  - Knowledge: 72.4%
  - Comprehension and Application: 67.0%
  - Higher Mental Activities: 45.3%

## EXAMINATION BLUEPRINT

Each question on the examination is classified in two ways: according to the cognitive level demanded by the question and according to the curricular content area being tested. The examination blueprint illustrates the distribution of questions according to these classifications. The numbers in square brackets [ ] indicate written-response questions, and those without brackets indicate multiple-choice questions.

| Reporting Category | Questions by Cognitive Level | | | Examination Emphasis (%) |
|---|---|---|---|---|
| | Knowledge | Comprehension and Application | Higher Mental Activities | |
| Light | 3, 8, 9, 11 | 1, 2, 4, 5, 6, 10 | 7<br>[4] | 23 |
| Electric and Magnetic Fields | 12, 13, 19, 22 | 14, 15, 16, 18, 20, 21, 23, 24, 25<br>[1] | 17, 26† | 27 |
| Electromagnetic Radiation | 27, 29 | 28 | [3] | 14 |
| Structure of Matter | 33, 34, 38, 42 | 30, 31, 32, 35, 36, 37, 39, 40 | 41, 43 | 20 |
| Modern Physical Theories | 44, 46, 49 | 45, 47<br>[2] | 48 | 16 |
| Examination Emphasis (%) | 24 | 50 | 26 | 100 |

## RESULTS and EXAMINER'S COMMENTS

The examination has a balance of question types and difficulties designed so that a student capable of achieving the acceptable standard would obtain a mark of 50% or better on the examination. Students achieving the standard of excellence would obtain a mark of 80% or better on the examination.

## MULTIPLE CHOICE

| QUESTION | KEY | DIFFICULTY * | QUESTION | KEY | DIFFICULTY | QUESTION | KEY | DIFFICULTY |
|---|---|---|---|---|---|---|---|---|
| 1 | C | 92.0 | 18 | A | 84.7 | 35 | B | 42.9 |
| 2 | C | 47.8 | 19 | B | 81.1 | 36 | A | 45.4 |
| 3 | C | 52.0 | 20 | D | 78.2 | 37 | D | 83.0 |
| 4 | B | 84.1 | 21 | A | 73.9 | 38 | B | 84.0 |
| 5 | B | 58.6 | 22 | D | 72.3 | 39 | A | 72.9 |
| 6 | D | 61.0 | 23 | C | 59.1 | 40 | D | 83.7 |
| 7 | B | 67.5 | 24 | B | 65.9 | 41 | A | 46.5 |
| 8 | A | 68.7 | 25 | D | 77.0 | 42 | D | 61.4 |
| 9 | D | 67.1 | 26 | Question deleted† | | 43 | C | 69.0 |
| 10 | A | 69.7 | 27 | A | 90.4 | 44 | A | 75.6 |
| 11 | A | 70.5 | 28 | A | 62.4 | 45 | D | 60.3 |
| 12 | C | 67.4 | 29 | B | 80.2 | 46 | C | 69.1 |
| 13 | A | 64.8 | 30 | C | 75.3 | 47 | B | 67.1 |
| 14 | B | 55.4 | 31 | C | 62.5 | 48 | D | 42.0 |
| 15 | B | 74.6 | 32 | D | 83.3 | 49 | D | 77.8 |
| 16 | C | 66.7 | 33 | B | 69.8 | | | |
| 17 | C | 69.7 | 34 | C | 75.3 | | | |

*Percentage of students answering the question correctly

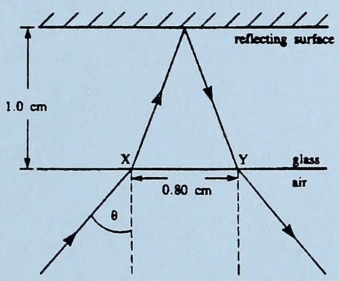
†Question 26 was dropped from the examination as the task set in the item was not the same for strong and for weak students.

## MULTIPLE CHOICE (continued)

A high level of competence in calculations was expected from all students. Students achieving the standard of excellence were expected to transfer knowledge to unusual problems and to use scientific generalizations effectively. Student performance on the multiple-choice section of the examination was generally satisfactory. As usual, students found calculation questions the easiest and had the most difficulty with questions demanding use of generalizations such as Newton's Law of Motion or the conservation laws. Detailed comments on questions 7 and 35 follow.

**Use the following information to answer question 7.**

Reflection in a Thick Mirror



Light enters the mirror at X and leaves at Y.

7. If the refractive index of the glass is 1.6, the angle of incidence θ must be

A. 40°
*B. 36°
C. 22°
D. 13°

Question 7 required students to use the properties of the isosceles triangle to calculate the angle of refraction and then to use Snell's Law to calculate the angle of incidence. Over two-thirds of the students were successful, and even of the weakest group of students, nearly half were able to select the correct answer. Shorter calculations on the examination were solved correctly by three-quarters or more of the students.

**Use the following information to answer questions 35 and 36.**

Observations in Photoelectric Experiments

I. The magnitude of the current increases.
II. The magnitude of the current decreases.
III. The magnitude of the current is constant.
IV. The energy of the photoelectrons increases.
V. The energy of the photoelectrons decreases.
VI. The energy of the photoelectrons is constant.

35. In a photoelectric experiment, a student increases the intensity of the incident light while maintaining a constant frequency. What are the effects on the magnitude of the photoelectric current and on the energy of the photoelectrons?

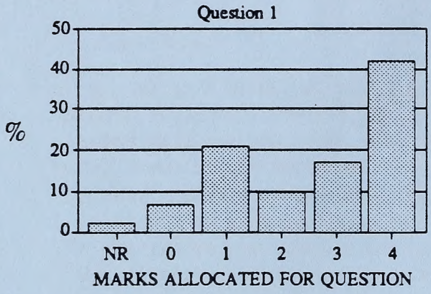
A. I and IV
*B. I and VI
C. III and IV
D. III and VI

Question 35 required students to make predictions of the key phenomena of the photoelectric effect. The manipulated variable and the variable held constant are clearly identified in the question, and the students were asked to predict the effects on two responding variables. Less than half of all students were successful, and for the weakest group of students, results were no better than could be expected from random guessing.

The multiple-choice average score of 69.0% was approximately 2.0% lower than could have been expected from the initial field-test results.

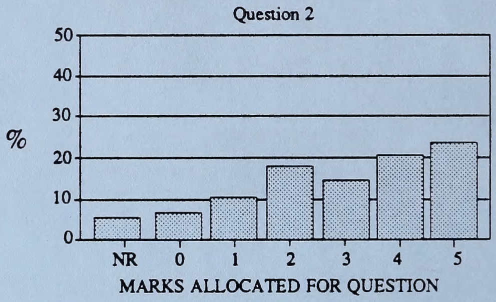
## WRITTEN RESPONSE

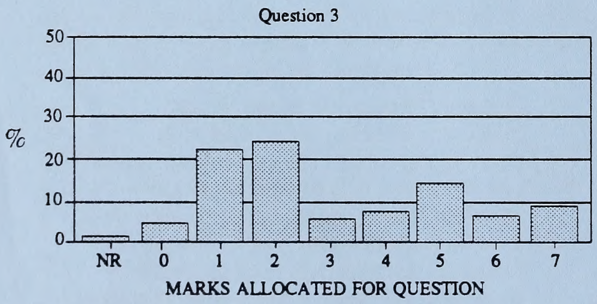
The four questions in the written-response section were chosen from four of the five content strands for physics. Students performing at the acceptable standard were expected to answer questions 1 and 2 well, and to answer the first part of question 3. Students performing at the standard of excellence were expected to answer questions 1 and 2 almost perfectly, and to get half marks or more on questions 3 and 4.



Question 1 was well answered by most students. Nearly half the students could both solve the problem and provide reasonable documentation for their solution. A significant number of students lost marks by arbitrarily setting the mass of the Earth as 1.0 kg rather than $1.0m_e$ or $5.98 \times 10^{24}$ kg. Similarly, the radius of the Earth was assigned the value of 1.0 m. Some students showed confusion between the terms mass and weight. On this 4-mark question, the average mark was 2.60 for 65.0% of the available mark.

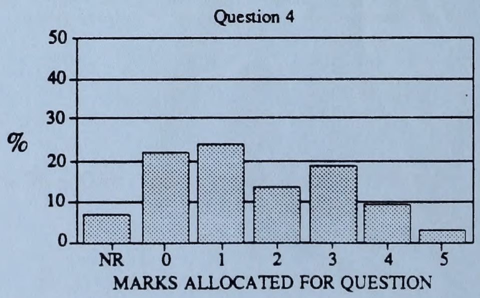
Question 2 showed a great variance in student responses. Many students gave impressive responses, with the correct answer supported by fully documented computations. A significant minority, however, still assumed that the Newtonian formula, $E_k = 0.5mv^2$, only needed a mass correction to be valid at relativistic energies. On this 5-mark question, the average mark was 2.91 for 58.2% of the available mark.





Question 3 was designed to test students' problem-solving skills. Half the students were unable to extract any information from either the data table or from the curved graph. Of those who could extract some information, most chose to plot wavelength and antinode separation. Fewer chose to plot antinode separation and the reciprocal of frequency. Both methods were accepted. Some students lost a mark for calculating a single estimate for the slit separation rather than basing the estimate on an averaging process. On this 7-mark question, the average mark was 3.10 for 44.2% of the available mark.

Question 4 was a new type, emphasizing the organisation and communication of verbal information. The results were lower than had been expected from field-test data, but many students wrote hurried answers, indicating that they may have been short of time. Students limited themselves unnecessarily in their discussion of similarities, in contrast to their treatment of differences, which was usually of sufficient depth. For the last part, students interpreted results in terms of theories supported rather than in terms of experimental observations. On this 5-mark question, the average mark was 1.65 for 33.0% of the available mark.



For further information, contact Phill Campbell or Jack Edwards at Student Evaluation and Records Branch, 427-2948.